

# Comparative Risk Analysis of Development of the Lignite Basins in Serbian Part of the Danube Region

SLAVKA ZEKOVIĆ, PhD, TAMARA MARIČIĆ, MSc  
Institute of Architecture and Urban & Spatial Planning of Serbia,  
11000 Belgrade, Bulevar kralja Aleksandra 73/II  
e-mail: [zeksbm@eunet.rs](mailto:zeksbm@eunet.rs), [tamaram@gmx.net](mailto:tamaram@gmx.net), <http://www.iaus.ac.rs>

*Abstract.* The paper gives an overview of the global business risks and risks in the mining development in the Kolubara and Kostolac lignite basins in the area of the Danube river in Serbia. An identification of main risks is undertaken by application of a comprehensive development framework approach, comparative analysis and Spider method. Risks in the development of mining are emphasized by global economic and financial crisis, as well as by the adoption of Kyoto Protocol regulations and mechanisms. The paper shows that the consideration and elimination of risk factors is important for the increase of competitiveness and energy efficiency in the lignite basins as an integral part of the efforts for achieving the sustainable development in the Serbian part of the Danube region.

*Key-Words:* Strategic business risks, Lignite basin, Mining and energetics, Danube region, Sustainable development

## 1 Introduction

The Kostolac lignite mining basin is located in the plain part of North-East Serbia, on the right bank of the river Danube, near the City of Požarevac. Kostolac lignite basin is connected with the rest of Serbia by highway in the European corridor X, railway and Danube. It covers 539 km<sup>2</sup>, while the production area encompasses ca. 28 km<sup>2</sup>. The development of coal mining in town Kostolac started already in 1870. Kostolac lignite basin is located in Požarevac municipality. In 2010 the City of Požarevac had 45,000 inhabitants and 22,000 employees, of which 3,500 were employed in coal-energy corporation (TEKO "Kostolac") - one of 11 companies in the composition of public enterprise „Electric Power Industry of Serbia“ (EPS). The company's total capital and commitments in 2009 were 593 million € and annual production was 8.6 million tonnes, while the average monthly salaries in 2010 were 500 €/per employee (more than twice of the average salary in Serbia, that is 320 €/monthly). The mining-energy and industrial capacities are located inside the basin – the Coal Mine, two thermal power plants (TPP) and many industrial enterprises that were, earlier, a part of the TEKO Kostolac corporation. The installed capacities are: coal production at 9 million t/per year; two TPPs of 1,007 MW with electricity production of 5,897 GWh/year or 14.4% of the total electricity gained from power plants in Serbia.

The second lignite basin - Mining and Energy Generation Basin "Kolubara" (MEGS "Kolubara") is located in the Belgrade metropolitan area, approximately 40 km south-west of Belgrade. Its surface area covers some 547 km<sup>2</sup>, while the production area encompasses ca. 134 km<sup>2</sup>. Industrial and related facilities and installations cover some 62 km<sup>2</sup>. Total population of the area is 82,000 inhabitants. More than 30,000 people are employed, out of which some 10,500 in the mining and energy generation sector [1]. Production of lignite open cast extraction in the Basin surpasses 30 million t/year, 65.7 million tonnes m<sup>3</sup> overburden and the average energy generation by its power plants reaches 1,161 Gwh/per year or 75% of the total annual lignite coal production in Serbia, and 3.1% of its total energy production [2].

In the strategic development planning of a mining and energetics area, it is necessary to include risk assessments. The key risks of the future development of Kolubara and Kostolac lignite basins are generally presented like business risks and strategic business risks in mining and energy sector.

Generally, the universal risks in the mining and energy sector have been classified as: [3] a) strategic, b) financial (prices, structure of capital, liquidity and loans, accounting and reporting), c) production risks (technical, social, planning, production channels, political, safety, joint venture investments) and d) risks due to the consent (legal,

regulative, standards of business management). According to the same source, the strategic business risks in mining sector are: *I – macro risks* (retaining social work permits, challenges of the climate change, resource nationalism), *II – sectorial* (industrial consolidation, lack of quality infrastructure, increase of regulations), *III – production risks* (certainty in energy use, rise of costs, access to infrastructure, shortage of skilled and educated workforce) [4]. Lack of knowledge, access to infrastructure, and necessary consolidation and restructuring of companies are risks that will seemingly augment in the near future. This classification has been helpful in assessing risks in the development of lignite basins in Serbian part of Danube region.

## 2 Methodological Approach

The identification of main risks of the development in the lignite basins is based on the comprehensive development framework approach. This approach is based on the principles of integrated and long-term holistic development, with focus on possible factors of uncertainties. The empirical evaluation of the spatial development of lignite basins in the Danube region has been conducted based on a comparative analysis of the indicators by Spider method. The Spider method is a tool used to compare and visualize relations of a territory or of development options, by using a relevant indicators.

## 3 Discussion on the Main Risks of the Development in Lignite Basins

We have identified ten principle risks for the development of lignite basins in the Serbian part of Danube region, as well as several others whose importance could increase in the coming years. The principle business risks in the development of lignite basins are:

### 1. Restructuring and privatization of the companies MEGS Kolubara and TEKO Kostolac

- For greater market power, increase of production and diversification of strategic business risk, mergers and acquisitions are generally often taking place in this sector. Risk assessment and increase of the capital costs can also be included in this due to the global economic crisis.

The basic orientations of development policies for the following period are determined by the development and modernization of the mining

and energy generation complex in the Danube area, according to the results of the restructuring and forthcoming privatization. The plan for restructuring of MEGS and TEKO companies, adopted by the Government of Serbia and steering committee of public company "Electric power industry of Serbia" (EPS), implies secession of two groups of companies: 1) core activities (mines, power plants and administration); 2) non-core activities (production and repair of mining and industrial equipment, metal constructions, cauldrons for power plants, machinery, rubber processing, transport services, maintenance, facilities cleaning and maintenance, recultivation, catering, construction, etc.). The restructuring program includes a social program for a few thousand workers redundant.

Resolving the question of debts towards the creditors of MEGS is vital for attracting the future partners. According to available data over 70% of debt is towards government creditors. Unless the current trend of unemployment growth is stopped, this would impede the possibility of establishing a new development concept that would include a necessary dimension of social sustainability as well. The restructuring and privatization of MEGS and TEKO will generate, apart from the already existing redundant employees, a new unemployment, which will make this problem even more difficult to solve.

### 2. Price of coal and electric energy

The average price of electric energy in Serbia is 5 euro cents/kWh which is less than in the EU-27 countries. The price of electric energy in Serbia still serves to maintain social peace, because electricity is cheaper than in the rest of Balkan region. Due to this fact, the value of energy system is debased and its development is limited in the long term. The low price of electric energy cannot provide the financial means necessary for investments. The price of electric energy should be on the average level of the South East European region. Serbia is obliged to have this average price also according to the *Energy Community Treaty of South East Europe* [5].

According to estimates [6], due to the global economic and financial crisis the mining sector has run into trouble. In 2008 there was a sharp fall in coal prices and share prices of mining companies. In August 2008 the average price of coal was about 146 EUR/t, in January 2009 - 67 EUR/t, while in March 2009 the price has fallen to 51.8 EUR/t [7]. The average price of electricity in the EU-15 countries in 2005 was 10.74 euro

cents/kWh, while in the EU-27 10.46 euro cents (with differences from 5.76 to 13.5 euro cents/kWh) [8]. The lowest rates were in Estonia - 5.76 euro cents/kWh, Poland 5.83 euro cents/kWh, and higher in the UK 10.15 euro cents/kWh, Germany 13.4 euro cents/kWh, Italy 14.4 euro cents/kWh. After the fall of electricity prices in 2009 to the level of 20-30 euro/MWh, prices began to rise slowly in 2010 [9]. The electricity prices in Europe in Q3 2009 were 40.9 euro/MWh and in Q2 2010 approximately 42.15 euro/MWh. The same trend of slow growth in 2010 was expected for the price of coal.

**3. Lack of investment funds** due to more severe conditions and the availability of funding sources in the financial market.

**4. Shortage of qualifications, knowledge and skills** - The growth and development of the sector imply qualified human resources, employees with skills and knowledge. Shortage of such human resources, especially managers, engineers and others is the main strategic business risk for the mining companies. Due to the shortage of highly qualified human resources, the average age of the employees in the company has increased. The rise of unemployment, economic problems in the business activity of basins, a fall in the standard of living and a rise in poverty, with a slow dynamic in the establishment of new enterprises in the private sector has started the immigration of the local population, in particular the young, educated workforce. Both lignite basins in Danube region employed more than 25,000 workers in 1990, but only 14,000 workers in 2010.

**5. Access to infrastructure** - The expansion of production in the mining sector is being faced with increasing obstacles regarding access to infrastructure. Infrastructure owners do not adequately follow the needs of mining complex, because they do not have clear signals from the market to invest in new infrastructural facilities (e.g., ports, ships, railways etc.) in order to maximize the production capacities in mining. Therefore, the mining companies are greatly tempted to own their proper infrastructure, which is a paradox. By combining the high risks of production with the low risks in the infrastructure sector, this could reduce the value of the enterprise.

The transportation and geographical position of Danube region, where MEGS Kolubara and TEKO Kostolac are located, is favorable. From viewpoint of the regional transportation communications, this region is located on the

European Corridor X and Corridor VII Danube river. Among the above-mentioned corridors PEN, network TINA and Corridor IV (Berlin-Istanbul) through Romania and Bulgaria are the greatest competitors to Corridor X in this part of Europe. One problem is the lack of government funds for quality maintenance of the rail infrastructure that occurred as a consequence of the overall situation in Serbia in the '90-ties. The lack of relevant port on Danube for transportation of raw materials, plaster and ashes for TEKO is evident today.

One of the uncertainties in future development of lignite basins is the possibility for a construction of the gas pipeline „South Stream“, or abandonment of its construction.

**6. Preserving social work permits** – Attempts to reach sustainable development in the mining sector are done through three components: environment protection, economic growth and social equality. Social work permits function as part of society and acceptable customs and behavior. Preserving permits or obtaining the new ones is becoming more difficult due to production growth. Mining companies have an image of “bad guys” who are dangerous, dirty and disruptive towards the environment.

According to Euracoal data [10], reserves of lignite in three basins in Serbia were 15.92 billion tonnes (including Kosovo basin). Reserves of lignite in Kolubara basin are 1.8 billion tonnes and in Kostolac basin 0.6 billion tonnes. Under Danube riverbed and riverside near town Kovin there are around 269.8 million tonnes lignite [11]. In 1991 started exploitation by watercraft dredge in two pits under Danube riverbed. The annual lignite production in the area of Dubovačka island across Danube near Kostolac basin was 100,000 t.

In the Kostolac lignite basin there are deposits of oil and natural gas (on the Kostolac island and in the rural area). The start of exploitation of oil and gas in this area is planned for 2010-2020 by Russian company NIS [12].

**7. Harmonization with the EU legislation and application of the Kyoto Protocol, ratified by Serbia in 2007** [13] - The awareness of importance of climate change effects has increased in the last decade, as these effects imply: changes in regulations, costs of changes and harmonization, limitations of infrastructure, political instability, a sudden change in consumer behavior and strategic business risks in accordance with the new development mode of mining and industry towards a mandatory introduction of a low-carbon economy.

Emissions' trading is an important policy measure to reduce environmentally harmful emissions. Mining and power plant sectors and/or individual companies allocated a fixed number of emissions allowances by government for a specified period for a specific pollutant such as CO<sub>2</sub> or SO<sub>2</sub>. If a particular participant's actual emissions exceed these allowances, another participant's surplus allowances may be purchased to ensure a balance of emissions and allowances. This gives participants the choice of reducing emissions in actuality or by purchasing an appropriate number of allowances to match actual emissions. Because the total number of allowances is capped, emissions reductions will be made, but the place where these reductions are made is not important for global air pollutants (CO<sub>2</sub>). Undoubtedly the effect of CO<sub>2</sub> emissions trading will mean an increase in coal prices and electricity prices as the generators pass on their costs to consumers.

In the future, it can be expected that carbon will be labeled on products and traded globally, and that there will be strict regulations and significant taxes on carbon itself. Mining companies will have to adjust their business to the requirements of ecological regulations towards a low-carbon economy. Most companies will accept minimal responsibility and radically lower their carbon intensity. Low-carbon companies will have a competitive advantage on the market.

The EU Climate Package was adopted in December 2008, and includes the EU ETS Directive, Directive on renewable sources and Directive CCS [14]. The power plants capacities that use fossil fuels independent of their type will have to use the CCS (Carbon Capture System), which is becoming the general requirement for the industries of Europe. The industry will have to pay for the collecting, transportation and storage of carbon, which should be implemented by 2020. The focal point of storing carbon lies on its collection in accordance with the IPPC Directive, while the transport is regulated in accordance with the regulation on transporting natural gas.

In January 2009, the EC has adopted the Recovery Package with the proposal of 1,250 billion € for five big CCS projects. According to the CCS Directive, the countries will decide if they and where to build CCS, i.e., the companies decide if they will use CCS based on the conditions in the carbon market. The main goals and principles of this directive are to provide the legal framework for managing environmental risks. According to

the EU Directive of ETS, a public bid for the energy sector permits will start from 2013. The system of trading with CO<sub>2</sub> emissions is simultaneously a catalyst for the support of the CCS concept.

The EU has accepted to lower CO<sub>2</sub> emissions by 8% by 2012, which has certain implications on all sectors. In addition, the EU has committed to reduce its energy consumption for 20% by 2020, and that renewable energy sources participate with 20%. Till 2030 the countries of EU-27 should decrease emission of equivalent CO<sub>2</sub> for 16.4% [15].

According to Eurostat data, equivalent emissions of CO<sub>2</sub> in EU-27 were 5,045.37 million tones in 2007. The greatest contribution gave Germany - 956.1 mil t, UK 636.68 mil t, Italy 552.7 mil t, Spain 442, Poland 398.8 mil t, etc. Total CO<sub>2</sub> emission for Serbia in 2004 was 56.7 millions t or 242.5 kg CO<sub>2</sub> per person. Consistent data in 2003 emission of CO<sub>2</sub> in Serbia were 4.75 t/per capita [16]. Serbia is not listed in the Annex B of the Kyoto Protocol and is not obligated to reduce its greenhouse emissions, but was given the possibility to adopt this obligation. It is certain that the environmental protection costs will burden the business in Serbia even more in the future period. For the sanitation of environmental problems, great financial means are necessary. It is still unclear how the means for sanitation of environmental problems of lignite basins will be provided i.e., priority sanitation for the environmental hot spots.

Delaying the application of Kyoto Protocol would certainly postpone the writing of development documents which are based on the principles and criteria of sustainable development in the lignite basins in Serbia.

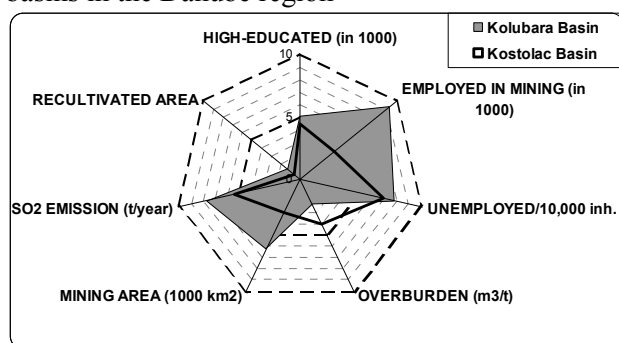
Price of permits for CO<sub>2</sub> emissions in January 2010 started to decline slightly after a period of growth. In 2009 price of the emission permits was 13.13 euro/t of CO<sub>2</sub>, while the expected level in 2012 is 11.38 euro/t of CO<sub>2</sub> [17].

**8. Increase of costs** - The increase in demand influences the increase in the use of production capacities. The danger of an increase in costs is vital for company competitiveness. Costs of energy, materials and labor are subject to inflation. This impact on the mining companies increases the pressure on the production limits resulting in the high-risk investment profile of the company, increases the advantage of portfolio optimization, consolidation and share of the risky arrangements.

In the era of the boom of commodity prices, the motto was „production at any cost”. During that period, there was no strict control of production costs. With the global financial crisis, this has changed and cost management at a corporate level is becoming an important business strategic risk. Uncertainties in the global markets, climate change and other factors force the companies to be careful in creating a new development mode and managing costs. The structure of costs of the mining industry mainly depends on local factors. Excessive costs of basic activities, especially of energy products, production costs, as well as the absence of necessary investments and the opening of new pits, could threaten competitive business activity of lignite basins in the Danube region in Serbia.

Comparative survey of the development indicators in the lignite basins in Danube region is shown in Fig. 1.

Fig.1. Indicators of development in the lignite basins in the Danube region



### 9. Ecological problems in the lignite basins.

According to the EU Program on the environment and sustainable development [18], it is estimated that the environmental quality in the Danube Basin in Serbia is among the most endangered in Europe. According to the Spatial Plan of the Republic of Serbia [19], in the planned state of environment, Kolubara and Kostolac basins are classified as much polluted sites. A hundred-year-old practice of mining has been the main source of degradation and environmental pollution in this region and wider. The worst effects were caused by the open pit mines and technological processes in TPPs.

Main environmental problems refer to air pollution, land degradation (both quality and visual impact) and water pollution. Opencast mines are located close to cities and other settlements. Dust from power plants creates a big problem for local environment but also has trans-boundary impact. TPPs in both lignite basins and dump ash located

on the bank of the Danube near Kostolac have large negative impact on the air, soil, ground- and underground water pollution in the Danube river alluvium, thermal load of the environment, even to the occasional detention of navigation on the Danube, etc. The emissions of CO<sub>2</sub> and SO<sub>2</sub> increased by 8-12 times due to the lack of desulphurization facilities. Emissions of airborne particulates increased 11-70 times, depending on the age of TPPs and efficiency of the electrostatic/electric filters. Mining activities, TPPs complex and overburden dumps are sources of degradation of agricultural land (ca. 3,000 ha in Kostolac lignite basin and 6,200 ha in Kolubara lignite basin, in 2010), and air pollution. EPS plans to invest 1.5 billion euro for building a new TPPs and creation of new open pits in the Kolubara basin, as well as 1.2 billion euro in environmental projects [20].

**10. Certainty in energy use.** Mining is energy intensive activity that depends on the efficient and sustainable energy supply. Insufficient investment in national infrastructure may induce restrictions in demand of mining companies. Mining companies are high-adjective of energy in the extraction of their products, such as energy producers and other sectors (power plants, steel factories, refineries, etc.). Oil prices, concern for climate change, energy hunger of emerging economies and political considerations are important elements for energy security. All this is happening at the moment when technical, physical and spatial conditions are deteriorated and when open pit and underground mining requires increasing overburden due to severe exploitation conditions.

**10. Increase of regulations** - With the uncertainties on the global energy market, political (and environmental) pressures on the mining and energy sectors are rising. This has an impact on competitiveness, security of resource usage and corporate responsibility. That become a growing complex of risks, especially because of the impact that national regulations have had on the sector's global position [2]. Some of the strategic risks such as consolidation of firms, climate change concern, preservation of social work permits and other all lead to an ambience in which the global regulators are increasing the requirements for the mining and energy sector. It is a complex issue and requirement, especially for big international corporations with business activities in many countries that are under the jurisdiction of several national regulations. The mining companies are exposed to the trend of an increase in regulation

and greater diversification of rules. Among other risks are [11]: emergence of independent rich funds, availability and limitations of water, increased importance of communication with NGOs and the public is a growing risk, introduction of private ordinary shares into the mining sector as a great strategic business risk.

## 4 Conclusion

Lignite is the base of Serbian energy development. The increase of competitiveness and energy efficiency in the lignite basins is an integral part of the efforts for the sustainable development of Danube region in Serbia. The main risks for the development of the lignite basins in Danube region are the following:

- 1) Delay in the process of restructuring, consolidation and the completion of privatization, as well as alternatives to a development that is not based on the principles of sustainability, could strengthen the current highly risky and socio-economically unacceptable trend of development.
- 2) Very important risk for the development in the lignite basins are environmental requirements for the optimal utilization of resources and the protection of the environment; growth of costs due to application of environmental regulative; overconsumption of energy products in the systems MEGS and TEK0.
- 3) The start of a new sustainable development cycle will be impeded, unless the problem with the lack of younger, highly-educated and highly-skilled population is not properly tackled.
- 4) Without technological innovations and new technological knowledge, the basins have no perspective for starting a development cycle.
- 5) The main risks for development of coal complex are: lack of capital for new investments, lack of working capital, and insufficient adjustment of production to a market-based economy.

In the following period, it will be necessary to implement complementary measures of energy and industrial policy, by which the mining-energy complex will gradually begin to eliminate its economic, social, and environmental-spatial risks.

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